Harnessing Nature's Diversity

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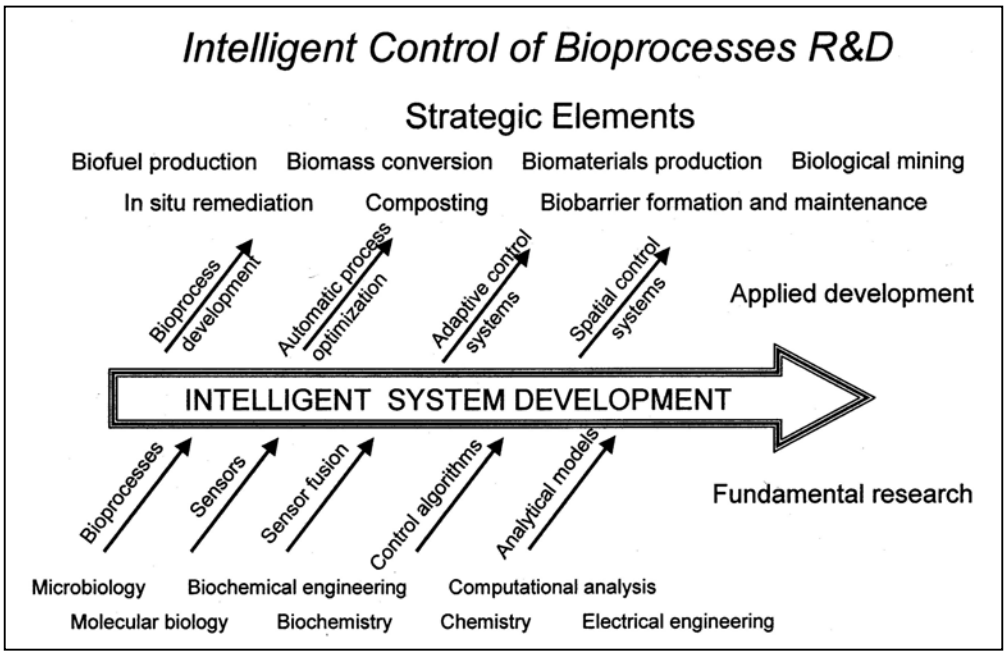
Intelligent Control of Bioprocesses

Artificial intelligence has the potential to incorporate human experience and reasoning into a computer. By emulating human thought processes and incorporating an extensive database in each control decision, artificial intelligence can radically alter the approach to bioprocess control and micro-biological research.

The advantages of learning-based control systems include that they:

- Learn as they operate
- Do not require previous knowledge or models
- Can determine coupled or interactive parameters
- Characterize functions
- Determine coupled or interactive metabolic processes independently of growth.



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Technical Contacts

Daphne L. Stoner, Ph.D.

Phone - 208-526-8786
Fax - 208-526-0828
Email - dstoner@inel.gov

Charles R. Tolle, Ph.D.

Phone - 208-526-1895
Fax - 208-526-0690
Email - tollcr@inel.gov

Management Contact

Dr. Melinda Hamilton

Idaho National Engineering and Environmental Laboratory
P.O. Box 1625, Idaho Falls, ID 83415-2203

Phone - 208-526-0948
Fax - 208-526-0828
Email hmn@inel.gov

Progress

We have developed learning-based intelligent control technologies for such microbiological systems as:

- Iron oxidation by a mesophilic bacterial culture, *Thiobacillus ferrooxidans*
- Iron oxidation by a mixed culture of mesophilic and thermophilic bacteria
- Cultivation of *Methylosinus trichosporium* with the bubbleless addition of methane and air.

Selected Publications/Presentations

D. L. Stoner, A. P. Poloski, J. A. Johnson, and C. R. Tolle, "Optimization and Control of Dynamic Bioprocesses," *Organic Process Research & Development*, Vol. 5, No. 3, 2001, pp. 299–307.

D. L. Stoner, K. S. Miller, D. J. Fife, E. D. Larsen, C. R. Tolle, and J. A. Johnson, "Use of an Intelligent Control System to Evaluate Multi-parametric Effects on Iron Oxidation by Thermophilic Bacteria," *Applied and Environmental Microbiology*, Vol. 64, 1998, pp. 4555-4565.

D. L. Stoner and C. R. Tolle, "Issues Involved with the Non-Characterized Control of Methanotrophic Bacteria," *Proceedings of the 16th Symposium on Energy Engineering Sciences. May 13–14, 1998, Argonne National Laboratory, Argonne, Illinois*, pp. 162–169, 1998.

D. L. Stoner, C. A. Browning, D. K. Bulmer, T. E. Ward, and M. T. MacDonell, "Direct 5S rRNA Assay for Monitoring Mixed-Culture Bioprocesses," *Applied and Environmental Microbiology*, Vol. 62, 1996, pp. 1969–1976.

J. A. Johnson and H. B. Smartt, "Advantages of an Alternative Form of Fuzzy Logic," IEEE Transactions on Fuzzy Logic, Vol. 3, 1995, pp. 149–157.